

# Velum-oral timing and its variability in Korean nasal consonants

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## INTRODUCTION

Studies on intergestural timing provides an opportunity to understand not only the coordination patterns [1, 2] but also the flexibility of these coordination [3, 4].

For example for *within-segment* intergestural timing, largely fixed timing relations are exhibited across contextual variations due to its tight coupling structures. But...

For within-segment **timing variability**, will the variability change as a function of syllable position or will it remain stable due to the relatively fixed within-segment timing relations?



**Onset lags**: onset nasals ≈ coda nasals ≈ geminate nasals

To investigate this, we examine timing variability across prosodic modulations in multi-gestural segments, focusing on velum and oral gestures in Seoul Korean nasal sequences.



The positive lag indicates that VEL precedes TT

#### Greater timing variability in the <u>onset nasals</u>

CoV: onset /n/ > coda /n/ & geminate /n#n/



**O-R lags**: onset nasals (near-zero) < coda & geminate nasals

 A near-zero O-R lag is indicative of almost no consonant nasality

### Greater timing variability in the <u>onset nasals</u>

CoV: onset /n/ > coda /n#p/ > coda /n#t/ & /n#n/

**Real-time Magnetic Resonance Imaging** speech production data of the midsagittal vocal tract (temporal resolution: 12ms/frame)

#### <u>Subjects</u>

Five native Seoul Korean speakers<sup>1)</sup>

#### <u>Stimuli</u>

Syllable-onset nasals (/#n/), syllable-coda nasals (/n#p/, /n#t/), & juncture geminate nasals (/n#n/) across three boundary/focus conditions (Wd, AP, & AP+focus; 7/8 reps each)

#### <u>Data analysis</u>

Velum (VEL): Velum centroid tracking analysis [5] Tongue Tip (TT): Region-of-interest image sequence analysis [6]

#### <u>Measurements</u>

Onset lag: the interval from the VEL lowering onset to the TT onset • O-R lag: the interval from TT onset to VEL raising onset (≈ articulatory duration of consonant nasalization)



#### Statistical testing

Linear mixed effects models for mean lags, and Coefficients of Variation (CoV) [7] using modified signed-likelihood ratio test [8] for comparing variances.

## CONCLUSION

- This study reveals articulatory grounding for phonological phenomena commonly observed in Korean such as *onset denasalization* or *nasal weakening* [9, 10].
- Korean onset nasals have a shorter duration of nasality than the coda nasals and are associated with greater variability.

In sum, intergestural timing is not merely a matter of contextual overlap, but rather syllable structure and variability in coupling relations are intrinsic to the representational specification for these segment-sized gestural molecules.

#### References

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#### 1) Out of five total subjects, one speaker's data are omitted due to a lack of

quantifiable VEL gestures in onset nasals (/#n/).

